

Instructor: Nicholas Corrente
Engineering Building C-162
Email: nicholas.corrente@rutgers.edu
Office Hours: TBD

Class: M, Tu, Wed, Th, 10:30AM-12:25PM

Course Description: This course introduces important concepts and a problem-solving framework fundamental to chemical engineering. We will focus on two key principles: 1) the conservation of mass, and 2) the conservation of energy. Application of these two principles is essential in the design and analysis of chemical engineering systems. We will first consider basic units, variables and conceptual representations (flowcharts and labels) used to describe chemical engineering processes, and then apply the conservation of mass to chemical engineering systems in the form of material balances. The study of material balances will include systems in which chemical reactions are occurring as well as systems containing multiple phases (gas, liquid) at thermodynamic equilibrium. Finally, we will incorporate the conservation of energy in the form of energy balances to analyze chemical systems undergoing heating and/or phase change.

The majority of the course will consist of problem-solving activities. Students will prepare in advance of class via assigned videos, reading, and homework. Class meetings will typically begin with a brief lecture by the professor. Most of the class session will be spent solving problems more challenging than the homework, with the professor and learning assistants (LAs) available to provide guidance and answer questions.

Learning Objectives:

1. Recall and explain all basic chemical engineering terms introduced in the course
2. Draw and label a flow chart from a process description; do this for any single or multiphase process
3. Write a process description from a labeled flow chart for any single or multiphase process
4. Perform a degree-of-freedom analysis on any process when given a flow chart or a process description and evaluate whether the problem can or cannot be solved
5. Set up material and energy balances for any given process description or flow chart
6. Solve material balances and energy balance for systems where the degrees of freedom are satisfied
7. Communicate effectively in expressing ideas and responding to questions about the course material
8. Apply the following concepts within the context of material and energy balance problems:
 - a. Reactive systems – limiting and excess reactants, fractional conversion, extent of reaction, yield and selectivity, combustion reactions
 - b. Single-component phase equilibrium – vapor pressure, boiling point, triple point
 - c. Gas-liquid systems – Raoult's Law, Henry's Law, saturation, humidity, phase diagrams, bubble/dew points
 - d. Thermodynamic concepts – enthalpy, heat capacity, internal energy, adiabatic, isothermal, latent heat
9. Gain experience using Microsoft Excel to solve problems related to the course material.

Course Materials:

Required textbook:

zyBooks

To purchase access:

1. Click on a zyBooks assignment link **on the Canvas site** (in 'Assignments' at the left-hand side of this page.) *Do not go to directly to the zyBooks website to create an account.*
2. Subscribe

A subscription is **\$64**. Subscriptions will last until Jul 17, 2025.

Recommended textbook:

1. Felder, R.M., Rousseau, R.W., Bullard, L.G. 2015. Elementary Principles of Chemical Processes, 4th Ed. John Wiley & Sons, NY.

This is the classic text for this course. It follows the same basic outline of topics as your zyBooks text but describes some material in more detail and many students find it useful as an additional source. Sections of the Felder text that correspond to the zyBooks assignments will be listed in each Canvas module. Earlier editions of the text are available and may be used.

Instructional Videos:

Brief instructional videos will be posted to complement textbook readings. Some of these videos were recorded by Dr. Alex Bertuccio, a former teaching professor in the CBE department at Rutgers. You can view his collection of videos on his [YouTube Channel](#). Some other videos are selected from the screencast library developed for this course at the University of Colorado-Boulder. Additional videos are available if you are interested in browsing them (<http://www.learncheme.com/screencasts/mass-energy-balances>), but only the assigned videos are required.

Software:

We will use Microsoft Excel throughout the semester. Rutgers students can download it for free here: <https://it.rutgers.edu/microsoft-office/>

Assessment:

1. Homework (zyBooks)	15%
2. In-Class Assignments (ICAs)	25%
3. Quizzes	10%
4. Reverse Engineering Assessments (REAs)	50%*
5. Participation	**
TOTAL	100%

Course Grade	% of Total Pts Earned
A	90-100
B+	85-89
B	80-84
C+	75-79
C	70-74
D	60-69
F	<60

* All REAs must be submitted and earn an average grade of 60% to pass the course.

** See Description of Graded Work below

Grades are not curved. Your course grade is directly related to the points you earn on the assessments. Decisions about borderline cases are at the professor's discretion. In those instances, demonstration of consistent effort to master the material and to participate and excel in the course may be factored into the decision.

Description of Graded Work:

All graded work will be submitted online via Canvas.

A Note on Late Work: Completion times for graded work are generous and it should be possible to do in the time allotted. Therefore, late submissions will not be graded. It is recommended that you plan and be prepared for the unexpected. For example, all your graded work except quizzes allows an unlimited number of submissions prior to the deadline. To avoid missing a submission due to a failed internet connection or other last-minute glitch, you can submit a draft of the work in advance and update it as you work on it until it is due. On rare occasion, a missing assignment may be excused in the case of a serious emergency; in such cases, documented certification is required. If you find you have difficulty submitting work on time, for whatever reason, it is important to speak to me so that we can try to resolve before your standing in the course is jeopardized.

1. Homework (zyBooks)

Reading from your zyBooks text will be assigned for nearly every class meeting. Practice Activities and Challenge Activities embedded in the reading will be assigned as homework and graded. The homework is due and must be completed before class (by 8:30 AM) on the due date to receive credit. For your zyBooks grade to be entered into the Canvas gradebook, it is important to remember two things: 1) Access zyBooks through the assignment link in Canvas (rather than going directly to the zyBooks website). 2) If you work ahead beyond the current zyBooks assignment, be sure to go back and click on the assignment link for those sections while the assignment link is active. The gradebook in Canvas should be updated automatically, and you are responsible for checking to ensure that your grade is properly recorded before the submission deadline. It is important to complete the zyBooks assignment prior to class, not only for credit, but also because it serves as the basis for the in-class discussion and assignment that day.

2. In-Class Assignments

Each class session will have an In-Class Assignment (ICA) based on the reading, homework, video assignments and lecture for that day. The In-Class Assignment will become available during class (not before), and students will work on it in class through a combination of individual and group work. The professor and LAs will be available during the class period to provide guidance and answer questions you may have as you work on the assignment. It should be possible to complete the majority of the In-Class Assignment during class. However, the rate at which individual students complete the work depends on many factors and tends to vary. Additional time *may* be provided on a case-by-case basis.

All In-Class Assignments will be accessed and completed in Canvas. Some questions on the assignments will be answered directly in Canvas. Other questions (especially as the semester proceeds and problems become more complex) must be submitted as a file upload to Canvas of a PDF or Word document. For all problems requiring file upload, zero points will be awarded if the answer is given without showing any work.

80% of the points for In-Class Assignments are earned through effort. If it is clear that a considerable amount of thought and work was put into the homework set, 80% of the points will be awarded. The remaining 20% of points will be earned by clearly showing your work and reaching the correct answer.

Students must be present in class to submit the In-Class Assignments. Students who are not marked present will receive a grade of 0 for that day's In-Class Assignment. The instructor is aware that there may be extenuating circumstances that might prevent students from attending class. As such, the lowest 2 In-Class Activity grades will be dropped at the end of the semester.

3. Quizzes

Brief (10-15 minute) quizzes will be given in class approximately every other week. These will be short answer quizzes and will focus primarily on recall and conceptual questions. Although you are not prohibited from consulting outside sources during the quiz, there is generally not enough time to do so. It is highly advisable to prepare for these as if they are closed book/closed notes. Students must be present in class to attempt quizzes. Students who are not marked present will receive a grade of 0 for that day's quiz.

4. Reverse Engineering Assessments

In lieu of exams for this course, the Reverse Engineering Assessments (REA) will be the major means to demonstrate your knowledge and mastery of the course content. In general, the REA will prompt you to write one or more unique problems that align with specific material taught in class. Each problem you create must be completely written by yourself. Problems and figures must be typed. Typed solutions are required; some portions may be handwritten if indicated in the instructions. All work must be neat and legible. Rubrics will be provided as needed. Submissions will be automatically reviewed for plagiarism by Turnitin.

To pass the course, all REAs must be submitted and an average grade of 60% must be earned on them.

5. Rutgers SIRS Course Survey

Near the end of the semester, you will be asked to complete the online Rutgers Student Instructional Rating Survey (SIRS) for this course. To receive credit, you will need to take a screenshot of the message confirming that you have completed the SIRS survey for this course on Canvas. Be sure the screenshot includes your name and the course name; otherwise, you will not receive credit for this assignment.

6. Participation

Participation is not graded explicitly, but is strongly encouraged. Participation may factor into your grade if you are on the border between two letter grades at the end of the course. Some examples of participation include (this is not an exhaustive list): attending class sessions, willingness to ask and answer questions during class, seeking help if you are having difficulty with the material.

Class Policies:

Class Attendance

Attendance of all class sessions is required, and attendance will be taken during each class. Class activities are an important part of the course. If you have circumstances that you anticipate might make that difficult, or if you have an urgent matter that arises during the semester, please discuss with me as soon as possible so that we can determine the best way to address it. If you miss class, it is **your** responsibility to catch up on the work. The instructor will not provide individual updates or an individual review of the material. **A maximum of four absences are permitted during the course, regardless of reason or excuse. Students who miss more than four classes will receive a grade of F for the course.**

Religious Holidays

If you celebrate a religious holiday that conflicts with class or prevents you from completing an assignment, please let me know by the end of the **second week of class** so we can determine the best way to accommodate.

Other Excused Absences from Class

Other situations that may warrant an excused absence include a certified medical excuse and required active military duty as certified by your commanding officer. You are responsible for discussing arrangements with me as soon as possible **prior** to the absence (except in emergency) to arrange for accommodating the missed work.

Accommodations for Learning

If you have a documented disability and require academic accommodations, it is important that you contact the Office of Disability Services (dsoffice@echo.rutgers.edu) to arrange for a letter of accommodations.

Regrading

After an assignment/assessment (e.g. quiz, ICA, homework, or REA) grade has been returned you will have **one week** to request a regrade. For a request to be considered, you will have to electronically submit a written PDF document explaining a) why you want your assignment/assessment regraded, and b) if the material is regraded, how many points you believe should be returned to the regraded item. Please note that if the argument is not convincing, or is flawed, you will not receive the points. If all directions are not followed for regrading, then the work will not be regraded, the grade stands, and no additional requests can be submitted for that assignment.

Technical Difficulties

Because we will be relying on multiple technologies, it is important to plan ahead and be prepared for technical difficulties that may arise. For issues with zyBooks, contact their Help Center (click on '**? Help/FAQ**' at the top of the zyBooks page). For issues with Canvas, contact the Canvas Help Desk (Email: help@oit.rutgers.edu, Phone: 833-648-4357). For other tech support, contact Rutgers IT (help@oit.rutgers.edu, [833-OIT-HELP](tel:833-OIT-HELP)).

Email: I will typically respond to email between 9 am and 6 pm, Monday through Friday. I will try to reply as quickly as possible but may need up to 48 hours. If you email me on the weekend, I may not be able to reply until Monday.

Ethics & Academic Integrity

Students are expected to familiarize themselves with and adhere to the University policy on academic integrity at: <http://academicintegrity.rutgers.edu>. To paraphrase succinctly, cheating, plagiarism, and representation of someone else's work as your own is a violation of academic integrity. Any offense will be reported, and you will receive a grade of zero for the assignment. Additional measures may be taken depending on the severity of the offense.

Copyright Policy

Materials in this course—unless otherwise indicated—are protected by United States copyright law [Title 17, U.S. Code]. Materials are presented in an educational context for personal use and study and should not be shared, distributed, or sold in print—or digitally—outside the course without permission.

14:155:201 Chemical and Material Energy Balances Summer 2025

Week	Date	Day	Lecture	Topic	Assessment
1	5/27/2025	Tu	1	Course Overview; Engineering Calculations; Processes & Process Variables; Intro to Excel;	
	5/28/2025	W	2	Fundamentals of Material Balances	
	5/29/2025	Th	3	Linear Equations in Excel; Material Balances: Single-Unit Processes; Types of Process Units	
2	6/2/2025	M	4	Material Balances: Multiple-Unit Processes	Quiz 1
	6/3/2025	Tu	5	Material Balances: Multiple-Unit Processes	
	6/4/2025	W	6	Material Balances: Multiple-Unit Processes	
	6/5/2025	Th	7	Material Balances: Reactive Systems	Quiz 2 REA 1
3	6/9/2025	M	8	Material Balances: Reactive & Combustions Systems	
	6/10/2025	Tu	9	Material Balances: Reactive & Combustions Systems	Quiz 3
	6/11/2025	W	10	Single-Phase Systems: Ideal Gases	
	6/12/2025	Th	11	Single-Phase Systems: Ideal Gases	
4	6/16/2025	M	12	Multiphase Systems: Single Component Gas-Liquid	REA 2
	6/17/2025	Tu	13	Multiphase Systems: Single Component Gas-Liquid	Quiz 4
	6/18/2025	W	14	Multiphase Systems: Multicomponent Gas-Liquid	
	6/19/2025	Th	15	Multiphase Systems: Multicomponent Gas-Liquid	Quiz 5
5	6/23/2025	M	16	Fundamentals of Energy Balances; Energy Balances: Thermodynamic Data Tables	REA 3
	6/24/2025	Tu	17	Energy Balances: Steam Tables	
	6/25/2025	W	18	Energy Balances on Nonreactive Processes	Quiz 6
	6/26/2025	Th	19	Energy Balances: Single-Phase, Nonreactive System	
6	6/30/2025	M	20	Energy Balances: Single-Phase, Nonreactive System	
	7/1/2025	Tu	21	Energy Balances: Phase Change Operations	
	7/2/2025	W	22	Energy Balances: Phase Change Operations	
	7/3/2025	Th	23	Energy Balances: Phase Change Operations	REA 4

*this schedule may be modified as needed at the discretion of the instructor

Rutgers Academic Policies and Student Support:

Rutgers University has compiled a website that includes many resources to promote student success, please see success.rutgers.edu.

Academic Integrity

115 College Avenue, New Brunswick | (848) 932-9414 | academicintegrity.rutgers.edu

Academic integrity is essential to the success of the University's educational and research missions, and violations of academic integrity constitute serious offenses against the entire academic community. The principles of academic integrity require that a student:

- Properly acknowledge and cite all use of the ideas, results, or words of others.
- Properly acknowledge all contributors to a given piece of work.
- Make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of impermissible materials or impermissible collaboration.
- Obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions.
- Treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress.
- Uphold the canons of the ethical or professional code of the profession for which he or she is preparing.

Rutgers University is committed to fostering an intellectual and ethical environment based on the principles of academic integrity. Every member of the University community bears a responsibility for ensuring that the highest standards of academic integrity are upheld.

Engineering Student Advising: Office of Academic Services

Engineering B100, Busch Campus | (848) 445-2212 | soe.rutgers.edu/oas

Undergraduate advisors and deans are available to you at the School of Engineering to assist you with inquiries related to course planning, academic policies, professional development, scholastic standing, degree progress, withdrawal options, and more. Please visit soe.rutgers.edu/oas/advising for work-in and advising hours.

Academic Coaching, Tutoring, Learning Support

Rutgers Learning Centers | (848) 445-0986 | lrc.rutgers.edu

Academic coaching is a comprehensive service for students who want to improve their academic and self-management skills, such as time management, organization and study skills. The Rutgers Learning Centers offer this support to help students achieve their academic goals along with self-advocacy and independent, life-long learning. To schedule an appointment, you may visit their website or call.

Student-Wellness Services

Counseling, ADAP & Psychiatric Services (CAPS)

17 Senior Street, New Brunswick | (848) 932-7884 | rhscaps.rutgers.edu

CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professional within Rutgers Health services to support students' efforts to succeed at Rutgers University. CAPS offers a variety of services that include: individual therapy, group therapy and workshops, crisis intervention, referral to specialists in the community and consultation and collaboration with campus partners.

Violence Prevention & Victim Assistance (VPVA)

3 Bartlett Street, New Brunswick | (848) 932-1181 | www.vpva.rutgers.edu

The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty. To speak with someone immediately, call 848-932-1181.

Disability Services

Lucy Stone Hall, Suite A145, Livingston Campus | (848) 445-6800 | ods.rutgers.edu

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: ods.rutgers.edu/students/documentation-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: ods.rutgers.edu/students/registration-form.